

was ordained priest by the Bishop of Oxford, and finally appointed as first Vicar of St Paul's, Chatham, 1855. In 1858 he accepted the private living of Friezland, in the West Riding of Yorkshire, which he left in 1870 to become Vicar of St Matthew's, Leicester. In 1874 he was transferred to the important vicarage of Great Yarmouth, and in 1881 he was made a Canon of Norwich Cathedral. Finally, on the nomination of the Lord Chancellor, he became Rector of Burgh Castle, near Great Yarmouth. While at Great Yarmouth he did much to restore the historic parish church, to which he presented a magnificent oak pulpit. Canon Venables was a prolific writer on Church matters. He was a member of the Royal Commission on Patronage, and was select Preacher at Cambridge in 1883. His death took place 30th December 1906, at the age of eighty-five. He was elected a Fellow of the Society on the 11th of January 1856.

SAMUEL PIERPONT Langley was born at Roxbury, Massachusetts, on 22nd August 1834. After he had graduated at Boston High School in 1851, he took up civil-engineering and architecture as his profession. From childhood he had shown great devotion to scientific pursuits, especially to astronomy. He practised his profession for some thirteen years, but after spending part of the years 1864 and 1865 in travelling in Europe, and visiting foreign observatories and learned institutions, he decided on his return to devote his life to the pursuit of science.

His first scientific appointment was that of Assistant at the Harvard College Observatory in 1865. In the following year he was made Assistant Professor of Mathematics in the Naval Academy at Annapolis, a post he almost immediately relinquished to become Director of the Allegheny Observatory at Pittsburg, where he remained for twenty years.

In 1867-68 he was busy with the equipment of the observatory, and a little latter he arranged and carried out a plan for distributing standard observatory time to the existing railway system of the country. In 1869 he went to Kentucky, in charge of a party of the United States Coast Survey, to observe the total eclipse of the Sun, and in 1870 he joined a Government eclipse expedition and went to Jerez in Spain. The only other eclipse expedition he took part in was one to observe the eclipse of 1878 from the top of Pike's Peak.

His first interest at Allegheny was the Sun, and it was whilst he was there that he made his well-known drawings of sun-spots and other details of the Sun's surface. An eminent authority has said of these drawings that the better the detail of the Sun's surface is seen, the more closely does it resemble Langley's drawings.

It was about 1875 that he began to devote much attention to the measurement of the heat spectra of the Sun and other hot bodies. Experience convinced him of the insufficiency of the thermopile as a measuring instrument, and after four or five

years he was successful in the invention of the Bolometer. This instrument, as is well known, is an electrical thermometer on the principle of Wheatstone's bridge. With it he at once set to work to explore the infra-red spectrum of the Sun ; he extended it to regions of ten times the wave-length of the visible spectrum and mapped the lines in it ; other researches with the bolometer were on the action of the Earth's atmosphere in scattering and absorbing selectively the Sun's rays of all wave-lengths ; on the infra-red spectrum of the Moon, and a determination of its temperature, which he found to be a little above 0° C. ; an estimate of the constant of solar radiation by a new method ; and on the connection between temperature and distribution of radiation in the spectrum of heated terrestrial sources. All this was done between 1880 and 1888.

In 1888 he was appointed Secretary of the Smithsonian Institution. The Smithsonian Institution officially represents the interest of the United States in science, and the chairman of its board of directors is the President of the United States. Its immediate affairs are administered by the secretary, who has charge of many and various scientific interests, such as the National Museum, the International Exchanges, the Bureau of American Ethnology, the National Zoological Park, and others. These administrative duties necessarily occupied much of Langley's time, and it was now impossible for him to devote the same personal attention to his scientific researches as before.

A few years after his appointment he founded the Smithsonian Astrophysical Observatory, the object of which was to increase our knowledge of the natural agencies which control climate and life. One of the most important of these he believed to be the amount of heat radiated to the Earth by the Sun, and at the time of his death he was engaged in the problem of finding whether the amount was constant, or varied sufficiently to affect the climate of the Earth. About the same time he improved his bolometer by adding to it a photographic arrangement to record its readings automatically and continuously : by its means it became possible to map the whole of the energy spectrum of the Sun in a few minutes.

Perhaps Langley was more widely known for his studies in the problem of flight than for his astrophysical work, or his able direction of a great institution. He had always been interested in the question of flight, and first took it up seriously in 1889. In 1891 he published his "Experiments in Aerodynamics," and in 1893 "The Internal Work of the Wind." In these papers he demonstrated the theoretical possibility of flight by means of large sustaining surfaces and mechanical motors, and for the remaining years of his life he gave much time and thought to its practical realisation. Large models of his design for a flying machine were successfully flown between 1896 and 1903, and he was encouraged by his success to construct an aerodrome large enough to carry a man. Two trials of this machine were made on the Potomac river in 1903, but were foiled by accidents in the launching, fortunately

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without loss of life. No further trials were made owing to a combination of unfavourable circumstances, including failing health.

Langley's published papers are over a hundred in number. It was his aim in all his publications to write them in the simplest and clearest language, so that they might be understood by educated persons not specially read in the subject, and he took immense pains to try to achieve his aim. He was a Foreign Member of the Royal Society of London, a Correspondent of the Institute of France, Member of the Accademia dei Lincei of Rome, and of many others. He received the degree of D.C.L. from Oxford, and Sc.D. from Cambridge, besides many other honorary degrees; and he was a medallist of the Royal Society of London, the American National Academy of Sciences, and the Institute of France, and received the Diploma of the Royal Institution.

He had many interests outside his scientific work. One was psychical research, and for many years he was associated with both the American and the British Societies for Psychical Research. He showed a keen appreciation of the best in English and French literature, and had a special interest in George Borrow, of whose manuscripts he had a large collection. He was also much interested in the fine arts, and had a considerable knowledge of pictures.

He died on the 27th February 1906, at Aiken, South Carolina.

He was elected Associate of the Royal Astronomical Society in 1883.

B. C.

JEAN ABRAHAM CHRÉTIEN OUDEMANS was born at Amsterdam on the 16th of December 1827. At the age of sixteen he went to the University of Leiden to study astronomy under Professor Kaiser, and took his degree in 1852. In 1853 he was appointed as Astronomer at the Observatory which was then established on the roof of the University building, and occupied himself mostly with observations and computations of planets, comets and variable stars, which are published chiefly in the *Astronomische Nachrichten*. His first astronomical publication, however, dates from 1846.

In 1856 Oudemans was named Professor of Astronomy at the University of Utrecht, but the following year he resigned his professorship to take up his appointment of Chief of the Geographical Service in the East Indian Colonies. There he determined, in different parts of the archipelago, the latitude and longitude of a great number of stations, and executed with a staff of engineers the triangulation of the whole island of Java. He found time for more strictly astronomical work, observing two total solar eclipses, and taking part in the observations of the transit of Venus in 1874 as Chief of the Dutch expedition to the island of Réunion, his colleagues being Professor Bakhuyzen and Professor Kaiser.

In 1875 he returned to Europe, and became, for the second time, Professor of Astronomy and Director of the Observatory at Utrecht. This position he held till 1898, when he retired at the age of seventy years.